FIFTH GRADE SCIENCE

GRADE LEVEL CONTENT EXPECTATIONS

5 SCIENCE

v.12.07

Welcome to Michigan's K-7 Grade Level Content Expectations

Purpose & Overview

In 2004, the Michigan Department of Education embraced the challenge of creating Grade Level Content Expectations in response to the federal No Child Left Behind Act of 2001. This act mandated the existence of a set of comprehensive state grade level assessments in mathematics and English language arts that are designed based on rigorous grade level content. In addition, assessments for science in elementary, middle, and high school were required. To provide greater clarity for what students are expected to know and be able to do by the end of each grade, expectations for each grade level have been developed for science.

In this global economy, it is essential that Michigan students possess personal, social, occupational, civic, and quantitative literacy. Mastery of the knowledge and essential skills defined in Michigan's Grade Level Content Expectations will increase students' ability to be successful academically, and contribute to the future businesses that employ them and the communities in which they choose to live.

Reflecting best practices and current research, the Grade Level Content Expectations provide a set of clear and rigorous expectations for all students, and provide teachers with clearly defined statements of what students should know and be able to do as they progress through school.

Development

In developing these expectations, the Scholar Work Group depended heavily on the *Science Framework for the 2009 National Assessment of Educational Progress* (National Assessment Governing Board, 2006) which had been the gold standard for the high school content expectations. Additionally, the *National Science Education Standards* (National Research Council, 1996), the Michigan Curriculum Framework in Science (2000 version), and the *Atlas for Science Literacy,* Volumes One (AAAS, 2001) and Two (AAAS, 2007), were all continually consulted for developmental guidance. As a further resource for research on learning progressions and curricular designs, *Taking Science to School: Learning and Teaching Science in Grades K-8* (National Research Council, 2007) was extensively utilized. The following statement from this resource was a guiding principle:

"The next generation of science standards and curricula at the national and state levels should be centered on a few core ideas and should expand on them each year, at increasing levels of complexity, across grades K-8. Today's standards are still too broad, resulting in superficial coverage of science that fails to link concepts or develop them over successive grades."

Michigan's K-7 Scholar Work Group executed the intent of this statement in the development of "the core ideas of science...the big picture" in this document.

MICHIGAN Department of Education
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Curriculum

Using this document as a focal point in the school improvement process, schools and districts can generate conversations among stakeholders concerning current policies and practices to consider ways to improve and enhance student achievement. Together, stakeholders can use these expectations to guide curricular and instructional decisions, identify professional development needs, and assess student achievement.

Assessment

The Science Grade Level Content Expectations document is intended to be a curricular guide with the expectations written to convey expected performances by students. Science will continue to be assessed in grades five and eight for the Michigan Educational Assessment Program (MEAP) and MI-Access.

Preparing Students for Academic Success

Within the hands of teachers, the Grade Level Content Expectations are converted into exciting and engaging learning for Michigan's students. As educators use these expectations, it is critical to keep in mind that content knowledge alone is not sufficient for academic success. Students must also generate questions, conduct investigations, and develop solutions to problems through reasoning and observation. They need to analyze and present their findings which lead to future questions, research, and investigations. Students apply knowledge in new situations, to solve problems by generating new ideas, and to make connections between what they learn in class to the world around them.

Through the collaborative efforts of Michigan educators and creation of professional learning communities, we can enable our young people to attain the highest standards, and thereby open doors for them to have fulfilling and successful lives.

Understanding the Organizational Structure

The science expectations in this document are organized into disciplines, standards, content statements, and specific content expectations. The content statements in each science standard are broader, more conceptual groupings. The skills and content addressed in these expectations will, in practice, be woven together into a coherent, science curriculum.

To allow for ease in referencing expectations, each expectation has been coded with a discipline, standard, grade-level, and content statement/expectation number.

For example, **P.FM.02.34** indicates:

P - Physical Science Discipline

FM-Force and Motion Standard

02-Second Grade

34-Fourth Expectation in the Third Content Statement

Content statements are written and coded for Elementary and Middle School Grade Spans. Not all content expectations for the content statement will be found in each grade.

Middle School (5-7) Science Organizational Structure

Discipline 1 Science Processes	Discipline 2 Physical Science	Discipline 3 Life Science	Discipline 4 Earth Science
Standards and Statements *(and number of Content Expectations in each Statement)*			
Inquiry Process (IP) **Inquiry Analysis and Communication (IA)** **Reflection and Social Implications (RS)**	**Force and Motion (FM)** Force Interactions (2) Force (4) Speed (3) **Energy (EN)** Kinetic and Potential Energy (2) Waves and Energy (3) Energy Transfer (3) Solar Energy Effects (2) **Properties of Matter (PM)** Chemical Properties (1) Elements and Compounds (4) **Changes in Matter (CM)** Changes in State (2) Chemical Changes (3)	**Organization of Living Things (OL)** Cell Functions (4) Growth and Development (2) Animal Systems (2) Producers, Consumers, and Decomposers (2) Photosynthesis (3) **Heredity (HE)** Inherited and Acquired Traits (2) Reproduction (2) **Evolution (EV)** Species Adaptation and Survival (4) Relationships Among Organisms (1) **Ecosystems (EC)** Interactions of Organisms (1) Relationships of Organisms (3) Biotic and Abiotic Factors (2) Environmental Impact of Organisms (2)	**Earth Systems (ES)** Solar Energy (3) Human Consequences (2) Seasons (2) Weather and Climate (4) Water Cycle (2) **Solid Earth (SE)** Soil (4) Rock Formation (1) Plate Tectonics (3) Magnetic Field of Earth (2) **Fluid Earth (FE)** Atmosphere (2) **Earth in Space and Time (ST)** Solar System (1) Solar System Motion (5) Fossils (1) Geologic Time (2)

Science Processes: Inquiry Process, Inquiry Analysis and Communication, Reflection, and Social Implications

The science processes in middle school expand the students' inquiry abilities from simply raising questions based on observations, to generating scientific questions based on observations, investigations, and research. Students begin to recognize the question they are asking, the background knowledge that framed the question, and what steps they take to answer their question. Fifth grade students will design and conduct their own scientific investigations, with consideration of fair tests, variables, and multiple trials and sets of data. Students are expected to use data and research in their analysis and evaluation of data, claims, and information, and relate their findings to different situations and real-world problems. The instructional activities of a scientific inquiry should involve students in establishing and refining procedures, materials, and data they will collect. It is crucial for students to recognize the benefit of cooperating with their peers and sharing data and experiences through collaborative science discourse.

Physical Science: Forces and Motion

Students participate in an in-depth study of motion as related to a point of reference, distance, time, and direction. Their exploration into motion also presents high interest content for students to hone their skills in metric measurement and the use of tools and equipment appropriate to scientific investigations. The middle school experience of investigating balanced and unbalanced forces, and their relationship to the size of change in motion, provide concrete experiences on which a more comprehensive understanding of force can be based at the high school level. Students can move from qualitative descriptions of moving objects in the elementary to quantitative descriptions of moving objects and the identification of the forces acting on the objects.

The completion of the study in motion involves the exploration and identification of contact and non-contact forces and how they change the motion of objects. Students' everyday experiences in motion lead them to believe that friction causes all moving objects to slow down and stop. In-depth explorations into reducing the force of friction can help the students understand and demonstrate that a moving object requires friction to keep it moving. The understanding of objects at rest requires the students recognize that there are balanced forces in equilibrium, such as a book on a table or chair on the floor.

Life Science: Organization of Living Things, Heredity, Evolution

Fifth grade presents an appropriate time for introducing the study of human biology. Students develop an understanding of the main function of specialized animal systems (digestive, circulatory, respiratory, skeletal, muscular, nervous, excretory, and reproductive) and how animal systems work together to perform life's activities.

Students explore the traits of individuals and examine how traits are influenced by the environment and genetics of the individual. They distinguish between acquired and inherited traits of humans as well as other living things.

Further study of organisms' individual traits demonstrates how behavioral and physical characteristics help them survive in their environments. In the investigation of physical characteristics, students relate similarities in anatomical features to the classification of contemporary organisms.

Students conclude their investigations into animal characteristics and evidence of change by analyzing the relationship of environmental change and catastrophic events to species extinction and survival. They explore fossils to provide evidence of previously living things and environmental conditions, and how both have changed over long periods of time.

Earth Science: Earth Systems and Earth in Space and Time

In the fourth grade students were introduced to the relationship between the sun, moon, and Earth. They have a general understanding how the visible shape of the moon defines a month and the spin of the Earth defines a day. Fifth grade students explore seasons and their relationship to the tilt of the Earth on its axis and revolution around the sun. They define a year as one revolution of the Earth around the sun, explain lunar and solar eclipses based on the relative positions of the sun, moon, and Earth and finally, the effect of the moon's gravity on the ocean's tides. Students study the universe beyond the sun, moon, and Earth and describe the position, motion, and relationship of the planets and other objects in the sky to the sun.

Fifth Grade Science Standards, Statements, and Expectations

Note: *The number in parentheses represents the number of expectations.*

Discipline 1: Science Processes (S)

Standard: Inquiry Process (IP)
1 Statement (6)

Standard: Inquiry Analysis and Communication (IA)
1 Statement (5)

Standard: Reflection and Social Implications (RS)
1 Statement (7)

Discipline 2: Physical Science (P)

Standard: Force and Motion (FM)
Force Interactions (2)
Force (4)
Speed (3)

Discipline 3: Life Science (L)

Standard: Organization of Living Things (OL)
Animal Systems (2)

Standard: Heredity (HE)
Inherited and Acquired Traits (2)

Standard: **Evolution (EV)**
Species Adaptation and Survival (4)
Relationships Among Organisms (1)

Discipline 4: Earth Science (E)

Standard: Earth Systems (ES)
Seasons (2)

Standard: **Earth in Space and Time (ST)**
Solar System (1)
Solar System Motion (5)

SCIENCE PROCESSES

Inquiry Process

K-7 Standard S.IP: *Develop an understanding that scientific inquiry and reasoning involves observing, questioning, investigating, recording, and developing solutions to problems.*

S.IP.M.1 Inquiry involves generating questions, conducting investigations, and developing solutions to problems through reasoning and observation.

S.IP.05.11 Generate scientific questions based on observations, investigations, and research.
S.IP.05.12 Design and conduct scientific investigations.
S.IP.05.13 Use tools and equipment (spring scales, stop watches, meter sticks and tapes, models, hand lens) appropriate to scientific investigations.
S.IP.05.14 Use metric measurement devices in an investigation.
S.IP.05.15 Construct charts and graphs from data and observations.
S.IP.05.16 Identify patterns in data.

Inquiry Analysis and Communication

K-7 Standard S.IA: *Develop an understanding that scientific inquiry and investigations require analysis and communication of findings, using appropriate technology.*

S.IA.M.1 Inquiry includes an analysis and presentation of findings that lead to future questions, research, and investigations.

S.IA.05.11 Analyze information from data tables and graphs to answer scientific questions.
S.IA.05.12 Evaluate data, claims, and personal knowledge through collaborative science discourse.
S.IA.05.13 Communicate and defend findings of observations and investigations using evidence.
S.IA.05.14 Draw conclusions from sets of data from multiple trials of a scientific investigation.
S.IA.05.15 Use multiple sources of information to evaluate strengths and weaknesses of claims, arguments, or data.

Reflection and Social Implications

K-7 Standard S.RS: *Develop an understanding that claims and evidence for their scientific merit should be analyzed. Understand how scientists decide what constitutes scientific knowledge. Develop an understanding of the importance of reflection on scientific knowledge and its application to new situations to better understand the role of science in society and technology.*

S.RS.M.1 Reflecting on knowledge is the application of scientific knowledge to new and different situations. Reflecting on knowledge requires careful analysis of evidence that guides decision-making and the application of science throughout history and within society.

S.RS.05.11 Evaluate the strengths and weaknesses of claims, arguments, and data.
S.RS.05.12 Describe limitations in personal and scientific knowledge.
S.RS.05.13 Identify the need for evidence in making scientific decisions.
S.RS.05.15 Demonstrate scientific concepts through various illustrations, performances, models, exhibits, and activities.
S.RS.05.16 Design solutions to problems using technology.
S.RS.05.17 Describe the effect humans and other organisms have on the balance in the natural world.
S.RS.05.19 Describe how science and technology have advanced because of the contributions of many people throughout history and across cultures.

PHYSICAL SCIENCE — Forces and Motion

K-7 Standard P.FM: *Develop an understanding that the position and/or motion of an object is relative to a point of reference. Understand forces affect the motion and speed of an object and that the net force on an object is the total of all of the forces acting on it. Understand the Earth pulls down on objects with a force called gravity. Develop an understanding that some forces are in direct contact with objects, while other forces are not in direct contact with objects.*

P.FM.M.2 Force Interactions- Some forces between objects act when the objects are in direct contact (touching), such as friction and air resistance, or when they are not in direct contact (not touching), such as magnetic force, electrical force, and gravitational force.

P.FM.05.21 Distinguish between contact forces and non-contact forces.
P.FM.05.22 Demonstrate contact and non-contact forces to change the motion of an object.

P.FM.M.3 Force- Forces have a magnitude and direction. Forces can be added. The net force on an object is the sum of all of the forces acting on the object. The speed and/or direction of motion of an object changes when a non-zero net force is applied to it. A balanced force on an object does not change the motion of the object (the object either remains at rest or continues to move at a constant speed in a straight line).

P.FM.05.31 Describe what happens when two forces act on an object in the same or opposing directions.
P.FM.05.32 Describe how constant motion is the result of balanced (zero net) forces.
P.FM.05.33 Describe how changes in the motion of objects are caused by a non-zero net (unbalanced) force.
P.FM.05.34 Relate the size of change in motion to the strength of unbalanced forces and the mass of the object.

P.FM.M.4 Speed- Motion can be described by a change in position relative to a point of reference. The motion of an object can be described by its speed and the direction it is moving. The position and speed of an object can be measured and graphed as a function of time.

P.FM.05.41 Explain the motion of an object relative to its point of reference.
P.FM.05.42 Describe the motion of an object in terms of distance, time and direction, as the object moves, and in relationship to other objects.
P.FM.05.43 Illustrate how motion can be measured and represented on a graph.

LIFE SCIENCE

Organization of Living Things

K-7 Standard L.OL: *Develop an understanding that plants and animals (including humans) have basic requirements for maintaining life which include the need for air, water and a source of energy. Understand that all life forms can be classified as producers, consumers, or decomposers as they are all part of a global food chain where food/energy is supplied by plants which need light to produce food/energy. Develop an understanding that plants and animals can be classified by observable traits and physical characteristics. Understand tha all living organisms are composed of cells and they exhibit cell growth and division. Understand that all plants and animals have a definite life cycle, body parts, and systems to perform specific life functions.*

L.OL.M.4 Animal Systems- Multicellular organisms may have specialized systems that perform functions which serve the needs of the organism.

L.OL.05.41 Identify the general purpose of selected animal systems (digestive, circulatory, respiratory, skeletal, muscular, nervous, excretory, and reproductive).

L.OL.05.42 Explain how animal systems (digestive, circulatory, respiratory, skeletal, muscular, nervous, excretory, and reproductive) work together to perform selected activities.

Heredity

K-7 Standard L.HE: *Develop an understanding that all life forms must reproduce to survive. Understand that characteristics of mature plants and animals may be inherited or acquired and that only inherited traits are passed on to their young. Understand that inherited traits can be influenced by changes in the environment and by genetics.*

L.HE.M.1 Inherited and Acquired Traits - The characteristics of organisms are influenced by heredity and environment. For some characteristics, inheritance is more important; for other characteristics, interactions with the environment are more important.

L.HE.05.11 Explain that the traits of an individual are influenced by both the environment and the genetics of the individual.

L.HE.05.12 Distinguish between inherited and acquired traits.

Evolution

K-7 Standard L.EV: *Develop an understanding that plants and animals have observable parts and characteristics that help them survive and flourish in their environments. Understand that fossils provide evidence that life forms have changed over time and were influenced by changes in environmental conditions. Understand that life forms either change (evolve) over time or risk extinction due to environmental changes and describe how scientists identify the relatedness of various organisms based on similarities in anatomical features.*

L.EV.M.1 Species Adaptation and Survival- Species with certain traits are more likely than others to survive and have offspring in particular environments. When an environment changes, the advantage or disadvantage of the species' characteristics can change. Extinction of a species occurs when the environment changes and the characteristics of a species are insufficient to allow survival.

L.EV.05.11 Explain how behavioral characteristics (adaptation, instinct, learning, habit) of animals help them to survive in their environment.

L.EV.05.12 Describe the physical characteristics (traits) of organisms that help them survive in their environment.

L.EV.05.13 Describe how fossils provide evidence about how living things and environmental conditions have changed.

L.EV.05.14 Analyze the relationship of environmental change and catastrophic events (for example: volcanic eruption, floods, asteroid impacts, tsunami) to species extinction.

L.EV.M.2 Relationships Among Organisms- Similarities among organisms are found in anatomical features, which can be used to infer the degree of relatedness among organisms. In classifying organisms, biologists consider details of internal and external structures to be more important than behavior or general appearance.

L.EV.05.21 Relate degree of similarity in anatomical features to the classification of contemporary organisms.

EARTH SCIENCE

Earth Systems

K-7 Standard E.ES: *Develop an understanding of the warming of the Earth by the sun as the major source of energy for phenomenon on Earth and how the sun's warming relates to weather, climate, seasons, and the water cycle. Understand how human interaction and use of natural resources affects the environment.*

E.ES.M.6 Seasons- Seasons result from annual variations in the intensity of sunlight and length of day due to the tilt of the axis of the Earth relative to the plane of its yearly orbit around the sun.

E.ES.05.61 Demonstrate using a model, seasons as the result of variations in the intensity of sunlight caused by the tilt of the Earth on its axis, and revolution around the sun.

E.ES.05.62 Explain how the revolution of the Earth around the sun defines a year.

Earth in Space and Time

K-7 Standard E.ST: *Develop an understanding that the sun is the central and largest body in the solar system and that Earth and other objects in the sky move in a regular and predictable motion around the sun. Understand that those motions explain the day, year, moon phases, eclipses and the appearance of motion of objects across the sky. Understand that gravity is the force that keeps the planets in orbit around the sun and governs motion in the solar system. Develop an understanding that fossils and layers of Earth provide evidence of the history of Earth's life forms, changes over long periods of time, and theories regarding Earth's history and continental drift.*

E.ST.M.1 Solar System- The sun is the central and largest body in our solar system. Earth is the third planet from the sun in a system that includes other planets and their moons, as well as smaller objects, such as asteroids and comets.

E.ST.05.11 Design a model that describes the position and relationship of the planets and other objects (comets and asteroids) to the sun.

E.ST.M.2 Solar System Motion- Gravity is the force that keeps most objects in the solar system in regular and predictable motion.

E.ST.05.21 Describe the motion of planets and moons in terms of rotation on axis and orbits due to gravity.

E.ST.05.22 Explain moon phases as they relate to the position of the moon in its orbit around the Earth, resulting in the amount of observable reflected light.

E.ST.05.23 Recognize that nighttime objects (stars and constellations) and the sun appear to move because the Earth rotates on its axis and orbits the sun.

E.ST.05.24 Explain lunar and solar eclipses based on the relative positions of the Earth, moon, and sun, and the orbit of the moon.

E.ST.05.25 Explain the tides of the oceans as they relate to the gravitational pull and orbit of the moon.